

### **ABSTRACT OF THE DISCLOSURE**

A beam source has a plasma generating chamber and a gas inlet port for introducing a gas into the plasma generating chamber. The beam source includes a plasma generator for generating positive-negative ion plasma containing positive ions at a density of at least  $10^{10}$  ions/cm<sup>3</sup> and negative ions from the gas. The beam source also includes a plasma potential adjustment electrode disposed in the plasma generating chamber and a grid electrode having a plurality of beam extraction holes formed therein. The beam extraction holes have a diameter of at least 0.5 mm. The beam source has a first power supply for applying a voltage of at most 500 V between the plasma potential adjustment electrode and the grid electrode.